

Claims

- [c1] 1. An actuated seal assembly for controlling flow in a fluid path in turbomachinery comprising:
a seal;
a seal carrier coupled to said seal, said seal carrier disposed in said turbomachinery;
a displacement apparatus coupled to said seal carrier for positioning said seal to control said flow in said fluid path; and
a drive system for powering said displacement apparatus.
- [c2] 2. The actuated seal of claim 1, wherein said displacement apparatus is selected from the group consisting of an actuator and a return device.
- [c3] 3. The actuated seal of claim 1, wherein said displacement apparatus comprises an actuator and a return device for moving said seal radially with respect to a rotating member.
- [c4] 4. The actuated seal of claim 1, wherein said displacement apparatus is selected from the group consisting of springs, bellows, tubes, rods, cams, hydraulic cylinders, pneumatic devices, piezoelectric devices, wires, cables, bi-metallic materials, phase-changing materials, solenoids and combinations thereof.
- [c5] 5. The actuated seal of claim 4, wherein said tube comprises an inflatable tube.
- [c6] 6. The actuated seal of claim 4, wherein said rod is spring loaded.
- [c7] 7. The actuated seal of claim 1, wherein said seal is selected from the group consisting of brush seals, labyrinth seals, abradable seals, honeycomb seals, leaf seals, finger seals, ceramic seals, aramid seals, aspirating seals and combinations thereof.
- [c8] 8. The actuated seal of claim 7, wherein said wire is wound on a wire spool and coupled to said drive system
- [c9] 9. The actuated seal of claim 1, wherein said displacement apparatus is disposed to control each of said seal carriers in said seal assembly

- [c10] 10. The actuated seal of claim 1, wherein said displacement apparatus is disposed to control a plurality of said seal carriers in said seal assembly.
- [c11] 11. The actuated seal of claim 1, wherein said displacement apparatus is disposed to control a respective seal carrier in said seal assembly.
- [c12] 12. The actuated seal of claim 1, wherein said drive system is bi-directional.
- [c13] 13. The actuated seal of claim 1, wherein said drive system is selected from the group consisting of motors, electric power supplies and liquid drives.
- [c14] 14. The actuated seal of claim 13, wherein said motor is selected from the group consisting of a linear motor and rotary motor.
- [c15] 15. The actuated seal of claim 13, wherein said motor further comprises a coupling.
- [c16] 16. The actuated seal of claim 15, wherein said coupling is selected from the group consisting of a gear, cable and pulley.
- [c17] 17. The actuated seal of claim 1, wherein said seal carrier is disposed in a turbine housing.
- [c18] 18. The actuated seal of claim 1, wherein said seal carrier is disposed in a labyrinth seal.
- [c19] 19. An actuated seal assembly for controlling flow in a fluid path in a turbine comprising:
a seal;
a seal carrier coupled to said seal wherein the position of said seal carrier in said turbine is adjustable;
a displacement apparatus coupled to said seal carrier for positioning said seal to control said flow in said fluid path and
a drive system for powering said displacement apparatus.
- [c20] 20. The actuated seal of claim 19, wherein said seal is selected from the group consisting of brush seals, labyrinth seals, abradable seals, honeycomb seals, leaf seals, finger seals, ceramic seals, aramid seals, aspirating seals and

combinations thereof.

[c21] 21. The actuated seal of claim 20, wherein said wire is wound on a wire spool and coupled to said drive system.

[c22] 22. The actuated seal of claim 19, wherein said seal carrier is adjustable during operation of said turbine.

[c23] 23. A smart seal system for controlling flow in a fluid path in a turbine comprising:
a control processor for receiving a controllable property signal and generating a drive system signal;
a seal assembly to regulate said flow in said fluid path;
a drive system for receiving said drive system signal and generating a motive effort to displace said seal assembly to control said flow in said fluid path; and
a property sensor for sensing a controllable property of said flow in said fluid path and for generating said controllable property signal.

[c24] 24. The smart seal system of claim 23, wherein said seal assembly comprises a seal, a housing and a seal carrier.

[c25] 25. The smart seal system of claim 24, wherein said seal is selected from the group consisting of brush seals, labyrinth seals, abradable seals, honeycomb seals, leaf seals, finger seals, ceramic seals, aramid seals, aspirating seals and combinations thereof.

[c26] 26. The smart seal system of claim 23, wherein said drive system comprises a displacement apparatus coupled to said seal carrier for positioning said seal to control said flow in said fluid path.

[c27] 27. The smart seal system of claim 23, wherein said displacement apparatus is selected from the group consisting of an actuator and a return device.

[c28] 28. The smart seal system of claim 23, wherein said displacement apparatus further comprises an actuator and a return device.

[c29] 29. The smart seal system of claim 23, wherein said controllable property is

selected from the group consisting of temperature, pressure, relative position between said seal and a rotating member and rotational speed of said rotating member.

[c30] 30. The smart seal system of claim 23, wherein said drive system signal allows said drive system to control the distance defined between said seal and said rotating member.

[c31] 31. A smart seal system for controlling a flow in a fluid path in a turbine comprising:
a control processor for receiving a control property measurement and generate a drive system command;
a seal communications interface for receiving said drive system command and a controllable property signal and for transmitting said control property measurement and a drive system signal;
a seal assembly to regulate said flow in said fluid path;
a drive system for receiving said drive system signal and generating a motive effort to displace said seal assembly to control flow in said fluid path; and
a property sensor for sensing a controllable property of said flow in said fluid path and for generating said controllable property signal.

[c32] 32. The smart seal system of claim 31, wherein said seal assembly comprises a seal, a housing and a carrier.

[c33] 33. The smart seal system of claim 32, wherein said seal is selected from the group consisting of brush seals, labyrinth seals, abradable seals, honeycomb seals, leaf seals, finger seals, ceramic seals, aramid seals, aspirating seals and combinations thereof.

[c34] 34. The smart seal system of claim 31, wherein said drive system comprises a displacement apparatus coupled to said seal carrier for positioning said seal to control said flow in said fluid path.

[c35] 35. The smart seal system of claim 34, wherein said displacement apparatus is selected from the group consisting of an actuator and a return device.

- [c36] 36. The smart seal system of claim 34, wherein said displacement apparatus further comprises an actuator and a return device.
- [c37] 37. The smart seal system of claim 31, wherein said controllable property is selected from the group consisting of temperature, pressure, relative position between said seal and a rotating member and rotational speed of said rotating member.
- [c38] 38. The smart seal system of claim 31, wherein said drive system signal comprises command information so as to allow said drive system to control the distance defined between said seal and said rotating member.
- [c39] 39. The smart seal system of claim 31, wherein said seal communications interface is selected from the group consisting of a geo-synchronous L-band satellite system, a low earth orbit satellite system, a two-way paging system and a modem connection.
- [c40] 40. An actuating mechanism for turbomachinery comprising;
a housing having at least one cavity;
a channel disposed within said housing in flow communication with said cavity;
a lifting button disposed within said cavity movable between a retracted position and an extended position upon introduction of a pressurized medium;
and
a seal carrier, disposed adjacent said lifting button, so as to be moved radially by said lifting button upon introduction of said pressurized medium.
- [c41] 41. The actuating mechanism of claim 40, wherein said actuating mechanism is disposed in a steam turbine.
- [c42] 42. The actuating mechanism of claim 40, wherein said actuating mechanism is disposed in a gas turbine.
- [c43] 43. The actuating mechanism of claim 40, wherein said seal carrier includes at least one seal adjacent to a rotating member so as to create a pressure differential defined between high and low pressure areas on axially opposite sides of said seal.

- [c44] 44. The actuating mechanism of claim 43, wherein said seal is selected from the group consisting of brush seals, labyrinth seals, abradable seals, honeycomb seals, leaf seals, finger seals, ceramic seals, aramid seals, aspirating seals and combinations thereof.
- [c45] 45. The actuating mechanism of claim 40, wherein said seal carrier is disposed in a labyrinth seal.
- [c46] 46. The actuating mechanism of claim 40, wherein said pressurized medium comprises a gas.
- [c47] 47. The actuating mechanism of claim 40, wherein at least one washer is disposed concentrically about said cavity.
- [c48] 48. The actuating mechanism of claim 48, wherein a compliant mechanism secures said washer to said lifting button and is radially displaced upon introduction of said pressurized medium so as to radially move said seal carrier.
- [c49] 49. The actuating mechanism of claim 49, wherein said compliant mechanism is a bellows.
- [c50] 50. A method of retrofitting an actuating mechanism in a turbine wherein said actuating mechanism comprises a seal carrier disposed therein, comprising the acts (steps) of:
placing said actuating mechanism adjacent to said seal carrier such that said seal carrier is moved radially in correspondance with the position of a lifting button assembly on said actuating mechanism,
wherein said actuating mechanism comprises a housing having at least one cavity, a channel disposed within said housing in flow communication with said cavity, said lifting button assembly being disposed within said cavity movable between a retracted position and an extended position in correspondence with the pressure in said cavity.
- [c51] 51. A method of retrofitting an actuating mechanism in a turbine wherein said actuating mechanism comprises a seal carrier disposed therein, comprising the acts (steps) of:

placing said actuating mechanism adjacent to said seal carrier such that said seal carrier is moved radially in correspondance with the position of a lifting button assembly on said actuating mechanism,
wherein said actuating mechanism comprises a housing having at least one cavity, a channel disposed within said housing in flow communication with said cavity, said lifting button assembly being disposed within said cavity movable between a retracted position and an extended position in correspondence with the pressure in said cavity.

Patent # 4,623,450